

PC Support Advisor

The Essential Resource for PC Support Professionals

Update 70

Understanding ODBC

One day, we'll all use the same database language3

Mike Lewis explains what ODBC is, the philosophy behind it, and how it can help your efforts in data management.

File: A0816.1

Understanding Static Electricity

The shocking truth about those sparks9

A short burst of static can wipe out a disk or zap a motherboard. Mick Strefford explains what it is, why computers don't like it, and how to protect your equipment.

File: H0817.1

Re-engineering The Support Team

Planning and manning made easier11

Setting up a new PC support department? Considering reorganizing your existing one? Leigh Edwards offers some advice.

File: M0125.5

Optimising Winword And Excel Installations

Help cut those fat Windows apps down to size15

Dave Stott shows how to reduce disk space and make the programs run more efficiently.

File: A0619.1

Understanding CPU And RAM Upgrades

There's hope for that old machine yet19

There is no shortage of upgrade processors that claim to speed up your PCs. Chris Long outlines the options available.

File: H0620.1

On This Month's Utility Disk

*Utility for on-screen display of internal modem status
Time management/accounting utility for working on multiple projects
Duplicate file locator for DOS
Novell DOS 7 patches and updates*

"Share your ware" - says Robert Schifreen.

I received a call from a journalist friend of mine the other day. She was writing an article about Shareware and public domain programs and wanted to know which ones I used on a regular basis.

One program, a text file viewing utility called LIST, came instantly to mind. I've been using it for the last five years, on an almost daily basis. I was about to call her and tell her that I didn't make much use of shareware or PD, but I thought I'd better check my \UTILS directory first, in case there was something I hadn't thought of.

First in the list was XRAY, a wonderful shareware debugger for DOS. It opens a window on screen, in which is shown (in hex) a portion of the PC's memory. The window is updated in real time, and runs in the background so you can continue using the PC. It's wonderful for testing software, as you can instantly see the effects of your code.

Then came Odyssey, a comms package. I use Odyssey every day for reading and sending email, and for

connecting to the internet.

Next, two Windows utilities. PaintShop Pro, I use to tweak and crop the screen shots that you see in PCSA. MetaMouse lets you change the colour and shape of the Windows pointer.

Back to DOS, and SMAP shows a map of the PC's memory usage, plus details of which TSRs are loaded and which interrupts are being hooked. Useful when I'm trying to install new applications and need to keep memory usage to a minimum.

Then there are three programs which I wrote myself, years ago, which I still use. ALIAS is like DOSKEY, but with more features. HISTORY records, in a text file on disk, the text of all commands typed at the DOS prompt, plus the date and time. No more wondering whether I remembered to copy the right files onto that disk which I formatted and posted to a client last week - just look in HISTORY.LOG. And CLBEEP beeps the PC speaker whenever I hit Caps Lock, so I can correct it before I end up with a page of text that needs re-doing.

Oh, and not forgetting the two virus scanners that I use to supplement the commercial one that I run while preparing the PCSA Utility Disks. Or the Complete Works of WB Yeats (OK, so I read poetry in a window while I'm editing articles on SCSI. Is that so bad?). Or LPTX, which re-directs LPT1 to a file under DOS so I can grab the output of PrtSc and use it on PCSA's pages.

Next time someone tries to tell you that Shareware and public domain software is all about trivial utilities and games, have a look in your own \UTILS directory or check out a couple of local bulletin boards. There's some great software out there.

PCSA

PC Support Advisor

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Understanding ODBC

Mike Lewis explains what ODBC is and the philosophy behind it.

ODBC (Open Database Connectivity) was designed by Microsoft as an open standard. In a nutshell, it is an interface between applications and databases. So far, it has only been implemented for Windows, but it is in no way tied to that platform (a version for Apple's System 7 is under development). On the other hand, the databases which it accesses can reside on any platform - indeed, that is an essential part of the philosophy of the system.

A good way of describing ODBC is by analogy with printing. Although printers vary widely in their method of operation, any Windows application can output to any printer without knowing how a particular device works. It does this through a driver. If the application wants to print text in a certain font, it doesn't have to worry about escape sequences or PostScript commands; it simply tells the driver to switch to that font.

ODBC works in much the same way. If an application wants to retrieve a customer's telephone number, it doesn't need to know about data formats, indexes, transaction logs or other database internals. Instead, it calls up a database driver and says to it: give me the contents of the Phone field in the record whose customer code is X. The driver converts the request into instructions for the specific database, just as a printer driver does for a specific make and model of printer.

ODBC Components

There are four basic components - or layers - in an ODBC system: the application, the Driver Manager, the drivers and the data source.

The application is any Windows program that needs to access a database. It might be a general-purpose tool like a spreadsheet or word processor, or it might be a specialist application, such as a stock control

system. Either way, the application has to be specifically written as an ODBC client. You can't pick any program off the shelf and assume that it will work with ODBC.

Microsoft has recently converted all its major applications to ODBC. In Excel 5.0, for example, you can use ODBC to run database queries and paste the results into your worksheet. Other vendors are also releasing ODBC-aware programs. Programmers working in C or Visual Basic can develop their own ODBC applications by means of a software development kit, the ODBC SDK, which is available from Microsoft.

The second layer, the Driver Manager, is a specific program provided by Microsoft (or by the vendors of whatever other platforms eventually support ODBC clients). Its role is to load and unload drivers, and to route requests for data from the application

to a specific driver. It doesn't alter the information flowing between application and driver in any way, though it does perform some limited parameter checking. The Driver Manager is usually distributed free with ODBC applications; it will eventually form part of the Windows environment.

The third layer, the driver itself, is where the real work of ODBC is done. The driver does all the processing relating to a specific database. It interprets requests from applications, and either executes them itself or passes them to the database engine. Unlike two layers above it, the driver needs to know a lot about the mechanics of the particular database which it supports.

Obtaining Drivers

Where do drivers come from? Microsoft says that around 80 vendors

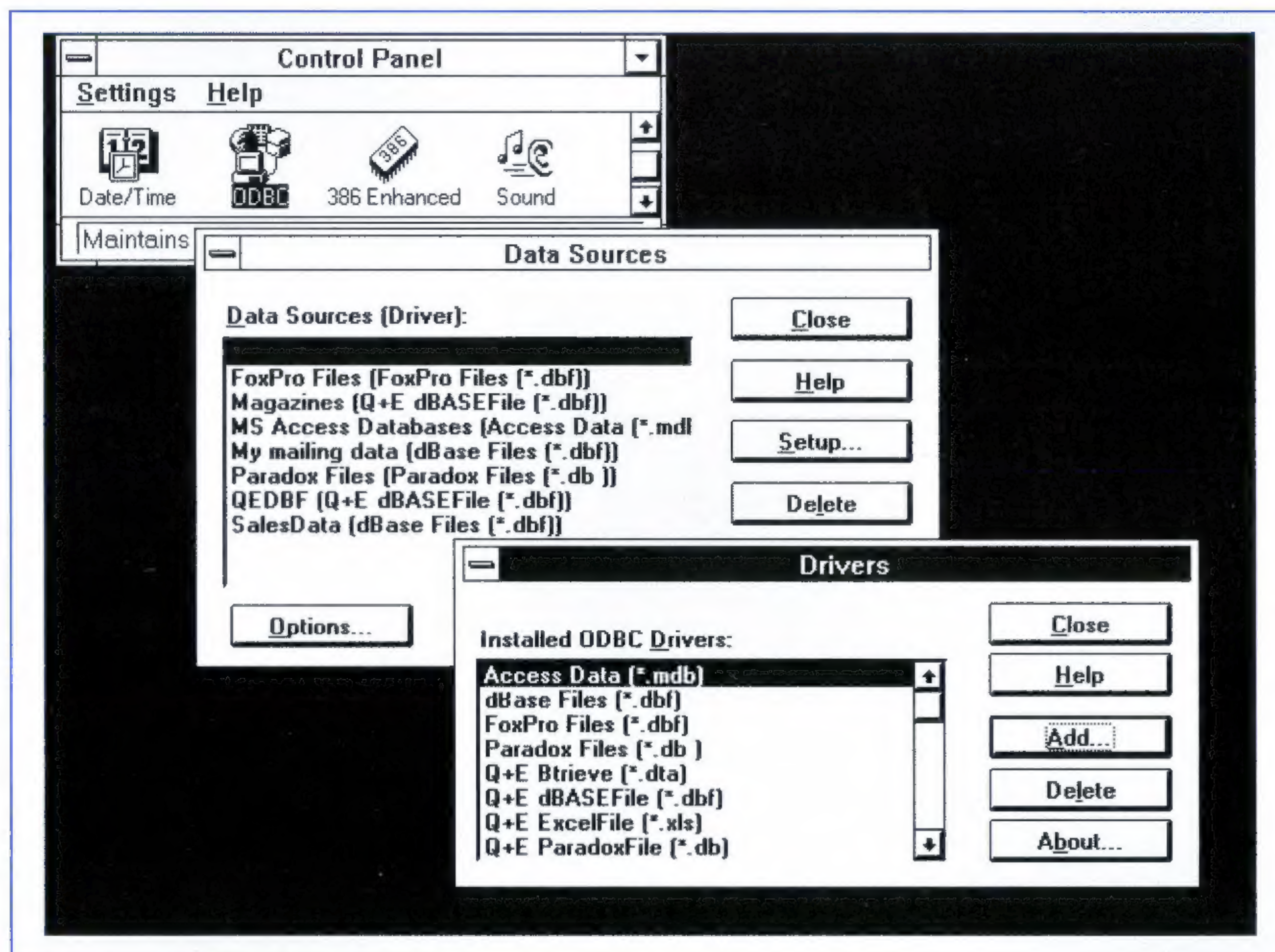


Figure 1 - The ODBC Administrator is used to install and remove ODBC drivers, in much the same way that Control Panel's Printer module adds and deletes printer drivers.

have "declared support" for ODBC, though this does not mean that there are 80 firms busily writing drivers for their databases. At present, drivers exist for about 25 different databases, though the number is increasing rapidly. Microsoft itself sells drivers for popular desktop databases such as Access, Paradox and dBASE, some of which are included with Microsoft's ODBC client applications. Other drivers are available from database vendors and from specialist companies such as Q+E Software (of which more later).

The final layer is the actual database, or, more correctly, the data source. The term data source is interpreted widely. It might be a full database management system running on a database server, such as Oracle or SQL Server. It might be a gateway that provides access to one or more DBMS. Or it might be a collection of data files, such as dBASE files or Paradox tables, stored on a shared network drive or a local hard disk. It does not even need to be a database in the usual sense of the word. An Excel worksheet could be a data source, for example.

Communicating

The various ODBC components communicate with each other by means of Structured Query Language (SQL). SQL is a concise language designed especially for manipulating and querying relational databases (for further details see the box "SQL primer"). It has been adopted by nearly all the major database vendors, although the different implementations suffer from wide variations in syntax. In part, ODBC arose out of an attempt by a multi-vendor body, the SQL Access Group (SAG), to standardise SQL syntax.

The Process

In ODBC, the client application generates requests for data in the form of SQL statements. The application sends the request to the Driver Manager, which in turn forwards it to the driver. What happens next depends on the nature of the data source.

If the data source is an intelligent DBMS which can itself understand SQL, the driver simply passes on the request, though it might modify it to take account of differences in syntax. The DBMS interprets the SQL and sends the results back to the application via the driver. This kind of driver is known as a multi-tier driver.

If, on the other hand, the data source is a simple collection of files, then the driver - called a single-tier driver - must itself process the query. Single-tier drivers incorporate both a SQL interpreter and a database engine. The driver performs the required operation on the data and returns the result to the application.

Conformance levels

One of the problems facing the designers of ODBC was the huge

variation in capabilities found among different databases. Within the relational DBMS world, many products boast advanced features which set them apart from their rivals. The developers of single-tier drivers also vary in the functionality they choose to provide. The challenge was to cater for these variations without restricting applications to a common subset of features.

The solution was to establish a system of conformance levels. The idea is that all drivers must offer certain minimum features. Beyond that, people writing drivers can choose the extent to which they will conform to ODBC standards.

There are two sets of conformance levels. The first one defines the functionality of the driver's API (application programming interface). Here, functions are grouped into three

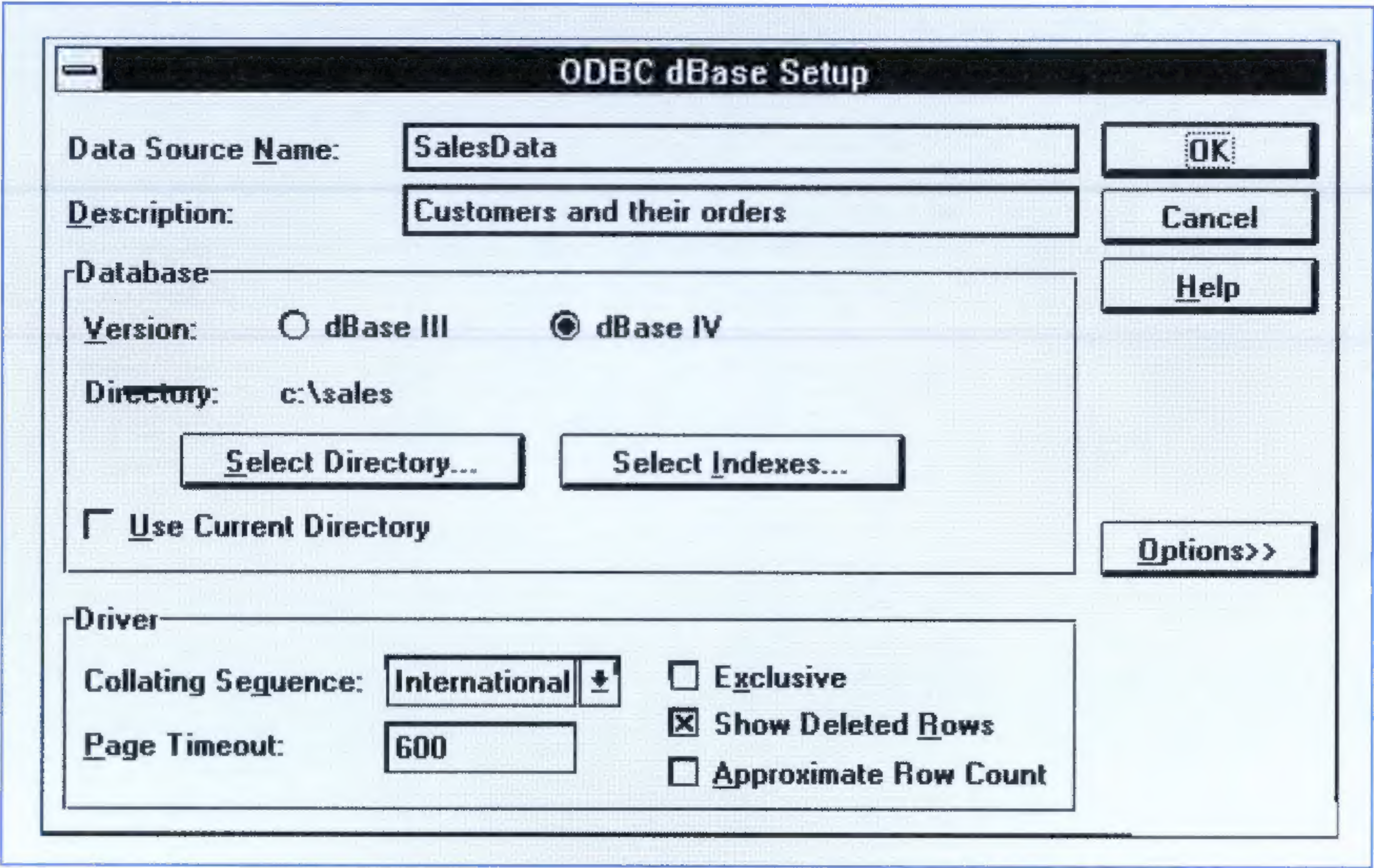


Figure 2 - The Administrator is also used to configure data sources. Here, we are establishing the C:\SALES directory as a data source for dBASE files.

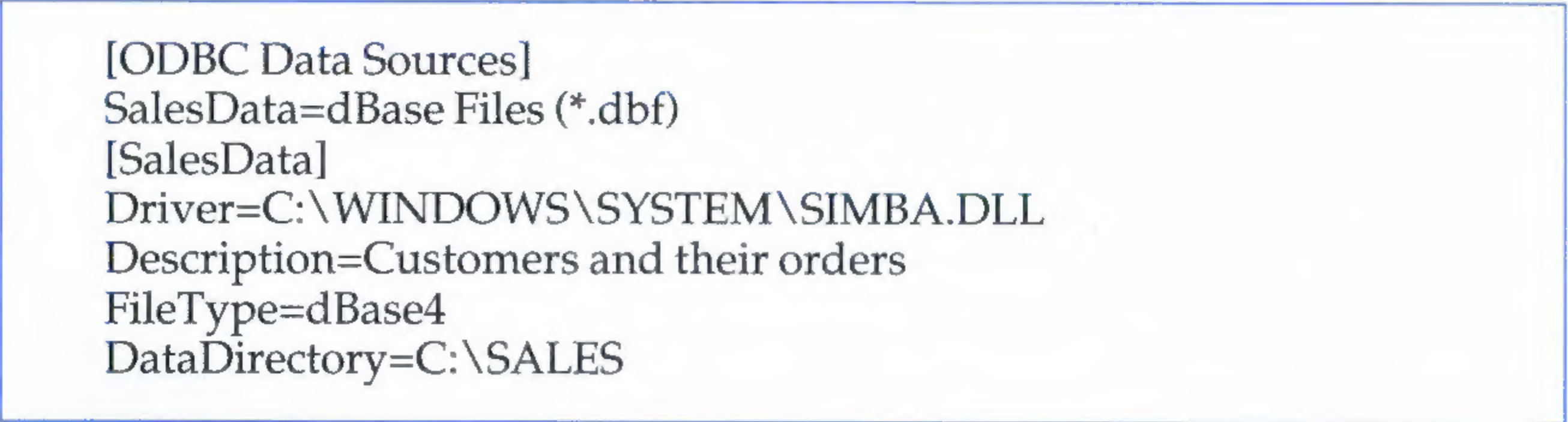


Figure 3 - Extract from ODBC.INI.

ODBC

levels: Core Level, Level 1 and Level 2. The other defines conformance to the SQL standard, this being Minimum SQL Grammar, Core SQL Grammar or Extended SQL Grammar.

The driver is obliged to declare its conformance levels to the client application. This means that the application can interrogate the driver and decide which features it wants to offer its users, depending on the capabilities of the data source currently being used.

```
[dBase ISAM]
CollatingSequence=ASCII
Deleted=On
Statistics=Truth
NetworkAccess=On
PageTimeout=600
```

Figure 4 - Extract from ODBCISAM.INI.

All this happens dynamically at run-time, rather than being decided in advance by the application programmer.

ODBC vs IDAPI

ODBC's main rival is the Independent Database Application Programming Interface (IDAPI), which is promoted jointly by Borland, IBM, Novell and WordPerfect. Like ODBC, IDAPI is based on SQL Access Group standards, but it was also designed to be suitable for "navigational" databases.

In brief, a navigational database is one that relies on a record pointer to move around a table. In contrast, "set-oriented" databases retrieve records in groups, according to some pre-defined criteria. dBASE is a

navigational database, whereas SQL supports set-oriented databases. This does not prevent ODBC from using SQL to retrieve dBASE data, but IDAPI, according to its supporters, is far better suited for handling navigational data.

ODBC In Practice

For the rest of this article, I'll explain the steps needed to implement ODBC in a typical client application. I've chosen Word 6.0 for Windows as an example, but similar concepts apply to other applications, especially those from Microsoft. I'll also show you how you can use a third-party library to add ODBC functionality to applications that do not otherwise provide it.

Installation

When you install Word 6.0 for Windows, the Setup program gives you the opportunity to install four Microsoft-supplied ODBC drivers. These drivers, which come free with Word, are for Access 1.0 and 1.1, FoxPro 2.0 and 2.5, Paradox 3.x and dBASE III Plus and IV. The same drivers are supplied with Microsoft's other ODBC client applications, which include Excel 5.0 and Access 1.1.

By the way, you might have noticed that Access is both a client and a data source. This is not as odd as it sounds. It is the Access program which is the client, and the Access data file (MDB file) which is the data source. This means that Access can read SQL Server data, for example, and Excel can read Access files.

You don't have to install the Microsoft drivers to use ODBC with Word. You are free to use drivers from other vendors, just as you are free to use the Microsoft drivers with other vendors' applications. This, after all, is the whole point of ODBC: to allow any application to access any data source for which a driver has been written.

Drivers are implemented as dynamic link libraries (DLLs). The four drivers supplied with Word are all packaged into a single DLL, named SIMBA.DLL. Drivers generally have their own help files. Those supplied

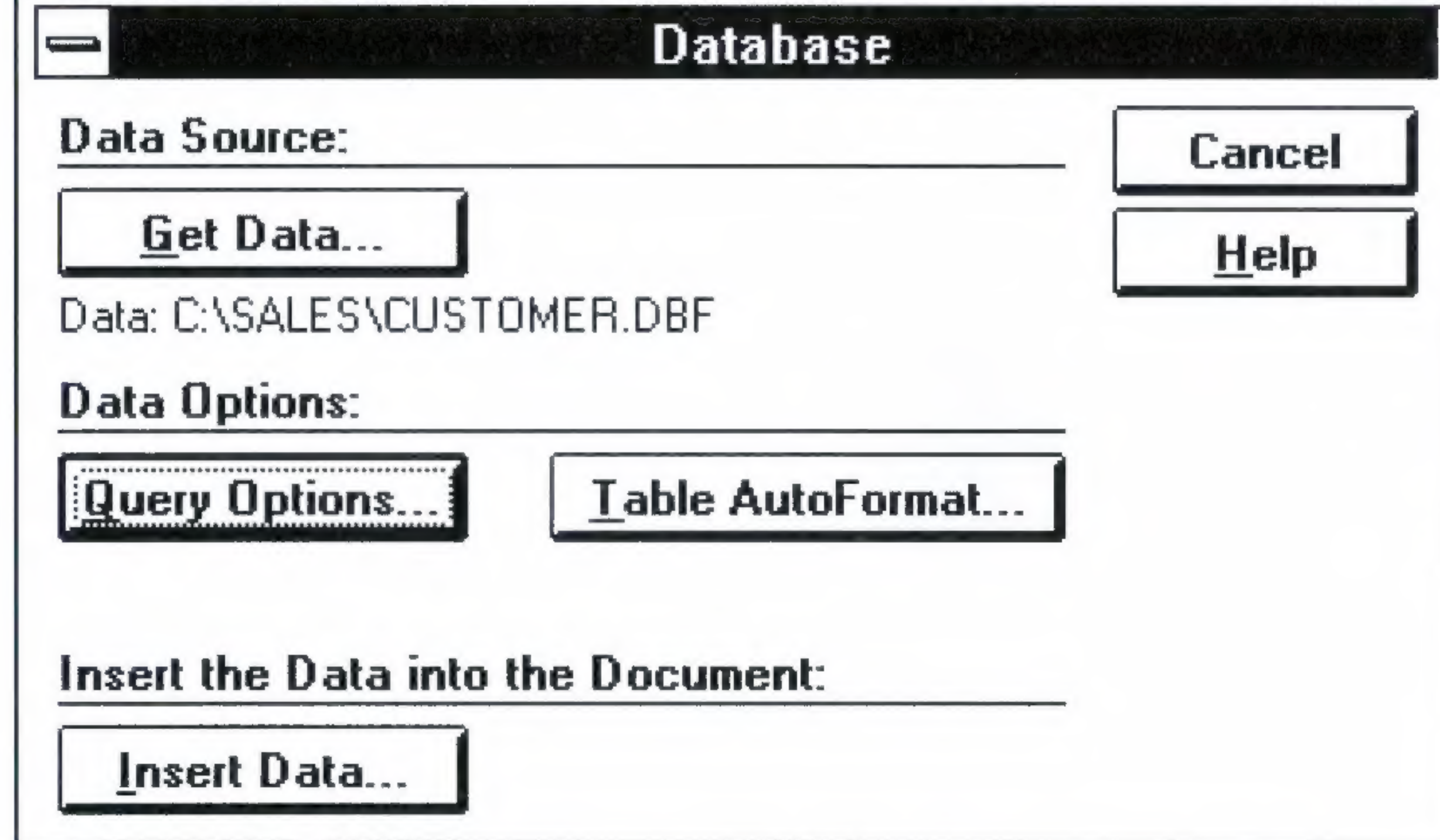


Figure 5 - In Word 6.0 for Windows, you use this dialogue to insert a table from an ODBC data source into a document.

```
' Declarations for some ODBC Extensions for Word functions

Declare Function SQLOpen Lib "WBODBC.WLL" \
(connect_name$, output_string$, driver_prompt As Integer) \
As Integer
Declare Function SQLClose Lib "WBODBC" \
(connect_num As Integer) As Integer
Declare Function SQLExecQuery Lib "WBODBC" \
(connect_num As Integer, query_text$) As Integer
Declare Function SQLRetrieveRows Lib "WBODBC" \
(connect_num As Integer) As Integer
Declare Function SQLRetrieveItem$ Lib "WBODBC" \
(connect_num As Integer, col As Integer, row As Integer) \
As String
```

Figure 6 - WordBasic declarations.

with Word have names in the form DRVxxx.HLP - for example, DRVPARDX.HLP is the Paradox driver's help file. Word Setup also installs the Driver Manager (ODBC.DLL) and a program called the ODBC Administrator (ODBCADM.EXE). All the files mentioned here reside in the System directory.

The ODBC Administrator

If ODBC is analogous to printer drivers, then the ODBC Administrator is the equivalent of the Printer module in Control Panel. You use it to add and remove drivers, and to manage data

sources. Although it is an EXE file and can therefore be run from Program Manager, it also exists as an icon within Control Panel. Figure 1 shows some of the Administrator's dialogues.

Before you can use a driver, you must use the ODBC Administrator (or an equivalent third-party program) to define a data source for it. The mechanics of this are straightforward, though the details vary according to the nature of the driver.

The drivers supplied with Word are all single-tier drivers, and for these the data source is always the directory containing the data files. In addition to

identifying this directory, you enter a name, an optional description of the data source, and various further details that are specific to the type of driver. Figure 2 shows the ODBC Administrator dialogue which you use to create a data source for Microsoft's dBASE driver.

INI Files

The ODBC Administrator stores details of the data source in the ODBC.INI file, which resides in the Windows directory. As with most Windows INI files, you are free to edit this file, although it is safer to use the Administrator if you need to alter the settings.

Figure 3 shows an extract from ODBC.INI. The [ODBC Data Sources] section lists the defined data sources. The remaining sections contain the actual definitions. This example indicates that we have defined a data source named SalesData, for the dBASE driver held in SIMBA.DLL, using dBASE IV data files held in the C:\SALES directory.

Additional information for the dBASE driver (and certain other drivers) is held in a file named ODBCISAM.INI - see Figure 4. This file contains settings that are common to all data sources that use the driver. For example, the entry "Deleted = On" says that records flagged as deleted will always be visible to the dBASE driver. Again, you would normally use the Administrator to adjust these settings.

Accessing The Data

Once you have defined a data source, you have two ways of accessing it within Word. One method is to use the Insert Database command. Selecting this command leads to a dialogue like the one in Figure 5. You press the Get Data button in this dialogue to tell Word which data source and table you wish to access. You then press the Insert Data button to copy the data into the document. You end up with a Word table, in which each row is a record and each column is a field.

More often, you will want to select certain records and fields for copying,

```
' Retrieves customer surnames and inserts them in document
' Written in WordBasic, using ODBC Extensions for Word.

Sub MAIN
ConnectNum = SQLOpen("DSN=SalesData", "", 0)
Reply = SQLExecQuery(ConnectNum, "Select Surname from Customer")
NumRows = SQLRetrieveRows(ConnectNum)
For i = 1 To NumRows
    Item$ = SQLRetrieveItem$(ConnectNum, 2, i)
    Insert Item$
    InsertPara
Next
Reply = SQLClose(ConnectNnum)
End Sub
```

Figure 7 - Example using ODBC Extensions for Word

```
' Prompts for customer code, retrieves customer's name and address, and inserts it them
' the document. Written in WordBasic, using Q+E Database Library
Sub MAIN
reply = qeLibInit          'Initialise Q+E
hdbc = qeConnect("DSN=SalesData") 'Connect to data

Target$ = InputBox$("Enter required customer code")
                        'Prompt for code
hstmt = qeExecSQL(hdbc, \
"Select * from Customer where Code = " + \
Chr$(34)+Target$+ Chr$(34))
                        'Send the query
If qeFetchNext(hstmt) = 0 Then
    ' query succeeded
    Item$ = qeValChar(hstmt, 2, "", 0) 'Field 2:
    Insert Item$                      'Customer name
    InsertPara
    Item$ = qeValChar(hstmt, 3, "", 0) 'Field 3:
    Insert Item$                      '1st address line
    InsertPara
    '
    ' get other fields in the same way
Else
    MsgBox("No such code")
End If
reply = qeEndSQL(hstmt)      'Close query
reply = qeDisconnect(hdbc)  'Close datasource
reply = qeLibTerm           'Close Q+E
End Sub
```

Figure 8 - Example using Q+E Database Library.

ODBC

rather than insert the table en bloc. You do this by pressing the Query Options button. This leads to a three-part dialogue, in which you can define record selection criteria, a sort sequence and the fields to be inserted. The other button in the Database dialogue, Table Autoformat, is used to choose the style of the Word table, and has nothing to do with ODBC.

The other way of getting at the data source from within Word is through the mailmerge function. Here, the end product is a set of mailmerged documents, in which each document corresponds to one record in the data source (subject to any selection criteria you specify). You invoke the function from the MailMerge command on the Tools menu. The mechanics are slightly more complex than the Insert Database command, but the general principle is the same.

With both methods, you are not confined to using ODBC data sources. Word can obtain data directly from Access or Excel, if those applications are installed on your system. It also has conventional file converters for importing data from Lotus 1-2-3, WordPerfect and other sources. None of this affects the mechanics of the mailmerge or Insert Database procedures, which always look the same to the user.

Limitations

Although the ODBC capabilities of Word are useful, they cannot be described as all-embracing. In particular, Word does not support any relational features, that is, it cannot retrieve data based on linked tables. Nor can you use it to write to the data source. You can arrange to update the Word document when the underlying data changes, but you cannot update the underlying data by editing the document.

These omissions do not reflect any limitations in ODBC. They are simply features that the authors of Word chose not to provide. The point is that ODBC does not automatically make an application into a general-purpose database front end - just as a printer driver does not automatically give access to all the functions that the printer

supports. It is up to the application's developers to decide what functionality to give to their users.

ODBC Extensions For Word

One way to avoid these limitations is to install the ODBC Extensions for Word. This is a Word add-in designed to open up ODBC for the benefit of WordBasic programmers. It comes in the form of a Word Link Library (WLL), which is a special type of DLL. The file, and related documentation, form part of the Microsoft Word Developer's Kit.

The ODBC Extensions for Word adds 16 functions to the WordBasic language. You use these functions to connect to a data source, to send SQL statements to the data source, and to retrieve the results. Between them, they allow a WordBasic programmer to take advantage of the full functionality of the ODBC driver. A drawback is that you need to have a smattering of SQL in order to use it (it's the programmer that needs the SQL, of course, not the end user).

To give you a flavour of how the library is used, I'll show you a short WordBasic macro that connects to a data source, extracts a field from every record in a table, and inserts it in the current document. For simplicity, I'll omit the necessary error processing and certain other details.

Because the functions in the ODBC Extensions are external to Word, the first thing we must do is to declare them to the macro - see Figure 6. Each line in this listing declares one function. Thus, the first line declares the `SQLOpen` function; it resides in the file `WBODBC.WLL`; it takes two strings and one integer as parameters (the dollar signs indicate strings); and it returns an integer. This syntax is part of WordBasic, and has nothing to do with ODBC.

Figure 7 shows the macro itself. It starts by calling `SQLOpen`, which establishes the connection to the data source identified in its first argument - `SalesData` in this case. The format of this argument varies with the driver. It might, for example, require a user name or password. If the connection

SQL Primer

You can use Structured Query Language (SQL) to perform a variety of data manipulation functions, but it is especially useful for formulating queries - thanks to its highly versatile `Select` command. For example:

```
Select * from Customer;
```

retrieves all the columns (fields) from the Customer table. To retrieve specific columns, you write

```
Select Surname, Balance from Customer;
```

To limit the selection to rows (records) that meet a specific criterion, you add a `Where` clause:

```
Select Surname, Balance from Customer
Where Balance > 1000;
```

Other `Select` clauses include `Distinct` (to retrieve unique values) and `Order By` (to sort the retrieved data). Thus:

```
Select Distinct Surname from Customer
Order by Surname;
```

returns a sorted list of unique surnames. You can also group the results:

```
Select City, Avg(Sales) from Customer
Group by City
```

```
Having Max(Sales) > 500;
```

This tells us the average sales by city, for all cities where the highest single sale has exceeded 500.

An important use for `Select` is to establish a link (a "join") between two or more tables:

```
Select Surname, City, OrderNum, OrderVal
From Customer, Orders
```

```
Where Customer.Code = Orders.CustCode;
```

Here we have a customer table and an order table linked on the common customer code, that is, on the `Code` column in the Customer table and the `CustCode` column in the Orders table. The query returns a row for each order, containing details obtained from both tables.

SQL has no user interface features, and so cannot display or print the query results. Indeed, the results exist only as a "virtual table", so a method is needed to make them available to the host program or application. The ODBC libraries described in this article include functions for extracting values from the result table and passing them back to the calling program.

succeeds, `SQLOpen` returns a connection number which identifies the data source to the other functions in the macro.

Having established a connection, the macro uses the `SQLExecQuery` function to send a SQL statement to the driver. The statement is coded as a character string, and is passed to the function as an argument. You can place any valid SQL statement here. In this case, the statement is: "Select Surname from Customer". This retrieves the Surname field from every record in the Customer table.

`SQLExecQuery` does not actually return the query results to the macro. To obtain the results, the macro has to call `SQLRetrieveItem$`. Each time that it is called, this function returns a single data item, identified by the field and record numbers specified in its arguments. In this case, the function returns the second field from each record in turn. The `SQLRetrieveRows` function tells the macro how many records there are in the query results. The final action of the macro is to call `SQLClose`, which closes the connection.

Q+E Database Library

The obvious disadvantage of the ODBC Extensions for Word is that it only works within the Microsoft Word environment. For a more general solution, you need to consider a third-party ODBC library, such as Q+E Software's Database Library (see box for contact details).

The aim of the Q+E Database Library is to provide a language-independent interface to ODBC. You can think of it as an extra layer, sandwiched between the application and the Driver Manager. Because it is implemented as a Windows DLL, it can be used with any application that can make DLL calls. Since many applications can call DLL functions through their scripting or macro languages, it follows that you can use the library to add ODBC functionality where it would not otherwise be available.

The basic functions within the library are not so very different from those found in the ODBC Extensions for Word. You use the same technique of sending an SQL query to the driver,

then separately retrieving the results. But the Q+E product has many features missing from the Extensions. They include extensive error handling, debugging and data conversion functions, as well as a complete interactive query builder which developers can include in their applications.

The Q+E Database Library is intended to be self-contained. It comes with its own copy of Microsoft's Driver Manager and ODBC Administrator, along with 13 ODBC drivers. Applications developed with the library may be distributed royalty-free, but the drivers themselves are intended for the developer's own use. End users must purchase their own drivers, either from Q+E or from other vendors.

Q+E example

To conclude this article, I'll demonstrate a short macro that uses the Q+E Database Library - see Figure 8. For consistency, I'll use WordBasic as the host language. You could equally well use C, Pascal or any macro or scripting language that can make calls to DLL. The macro prompts the user for a customer code, then retrieves the customer's name and address. As before, I have simplified the example by omitting certain details such as error handling.

The macro starts by calling `qeLibInit` to initialise the library, and `qeConnect` to connect to the data source (these, and all other Q+E functions used in the macro, must have previously been declared, as described earlier). It then calls WordBasic's `InputBox$` function to prompt the user for the customer code.

To send the SQL Select statement to the driver, the macro calls `qeExecSQL`. This is the equivalent of the call to `SQLExecQuery` in the previous example, except that here we are adding a Where clause to the Select statement. If the customer code is AB100, the macro would send `Select * from Customer Where Code = "AB100"`.

Note the use of `Chr$(34)` to insert the double-quotes into this statement. This is necessary because WordBasic uses double-quotes as a string delimiter.

After sending the query, the macro uses `qeFetchNext` to retrieve the results.

This function does not return any data to the macro. Rather, it moves the "current record" in the result set to the next record. The `qeValChar` function retrieves the values from this record. If `qeFetchNext` returns a non-zero value, it means that an exception condition has arisen, which in this case is taken to mean that the result set is empty. Having extracted the data, the macro inserts it into the current document. It then closes the SQL statement, closes the data source, and releases the library.

In Conclusion

Although it is still early days, ODBC has already become widely accepted by database vendors, application developers and end users - and with good reason. As well as helping to make databases more accessible, it has introduced a welcome openness in an area where proprietary systems are the norm. Whether you write your own database-aware applications, or simply support users who want quick access to their data, this is clearly a technology to watch.

Information

Q+E Database Library costs \$699 in the US. Q+E Software can be reached on +1 919 859 2220 (US), +44 273 489888 (UK), and +31 10 2202 022 (rest of Europe).

PCSA

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Understanding Static Electricity

A short burst of static can wipe out a disk or zap a motherboard. Mick Strefford explains what it is, why computers don't like it, and how to protect your equipment.

The effects of static electricity have been known for thousands of years. The Greeks found that if a piece of amber was rubbed with fur it would attract small pieces of hair. The word "electricity" is derived from the Greek word for amber - "elektron".

The process by which electricity is generated in this manner is now well understood. All matter consists of atoms which normally have equal numbers of positive protons in their nucleus and negative neutrons in an orbit around it. When two surfaces of dissimilar material are rubbed together, electrons from one will become dislodged and attach themselves to the other. The surface which has lost electrons is now positively charged and the one which has gained them is equally negatively charged. This process is known as Tribo Electrification and is particularly severe when one of the materials is an insulator. We have all experienced the process by which we become charged by, say, walking across a nylon carpet - the actual voltages involved are huge, with 20 kV being generated on a human body on a dry day.

The charging action goes on unnoticed, even though the body often reaches high potentials. What we do notice is the effect of all this charge flowing away quite rapidly the instant we touch a conducting object at a different potential, such as a filing cabinet or even another human body. The shock felt is caused by a discharge lasting around 10 ns and having a peak current of up to 40 A. Those who think most devices are not sensitive to Electro-Static Discharge (ESD) should consider whether they will withstand 20 kV at 40 A, albeit for only a short time.

A human may be regarded as a walking capacitor with values from 50 to 1000 pF, roughly proportional to body size. The largest single factor determining body capacitance is the type of material used for the sole on your shoes (assuming that you're standing up). Thick leather soles produce lower capacitance than thin plastic ones. The voltage that can be sustained by a human body in normal atmospheric conditions varies from 10 to 25 kV, although under exceptional circumstances the upper limit may be as much as 40 kV. Beyond this, corona effects bleed off the charge and provide a kind of clamping. The upper limit would normally be set by the amount of moisture in the atmosphere. The drier the air, the higher the upper limit.

ESD Damage

All components are susceptible to damage to some degree. Simply, the smaller and more delicate the features within the component, then the more damage that can be caused by ESD. So bi-polar transistors and TTL logic gates are less prone to damage, while field effect transistors and high density components such as MOS, CMOS and GaAs chips are much more sensitive to ESD and static fields. As new components become available with even higher densities and smaller, more delicate features then such devices will be even more susceptible to damage - less than 100 V of static charge may damage these components.

While static electricity is generally a nuisance, it can sometimes be put to good use. A charged item tends to attract small pieces of dust, paper etc. This is why your TV screen and monitor get very dirty as the high electric

field they produce attracts dust. Similarly if you pull out a piece of sticky tape and hold it above a piece of paper, the paper may jump towards the tape. This is because the charge on the tape induces an opposite charge on the upper surface of the paper - these charges then attract each other. This principle is employed in electrostatic air filters which remove dust and smoke particles from the atmosphere by passing the air over charged plates. The induced charge ("field effect") referred to above can damage modern semiconductor devices without even touching them; the charged field around a briskly walking person wearing nylon clothing under a polyester overall could be enough to induce fatal charges in devices up to half a metre away.

And of course laser printers work by charging the drum, using the laser to selectively discharge certain areas, then allowing the drum to attract toner to the areas which are still charged.

Damage Scales

The damage to a component may not completely kill it - it may only be "wounded" and will "die" (ie, completely fail) at some (normally unpredictable) time in the future. If the damage causes immediate total failure of a component then this should be apparent when the device is used or tested; another failure that brings with it the costs of repair and replacement. The wounded component is an even more difficult and costly problem. It may work enough to pass tests and diagnostics at the moment; but what of some time in the future (one hour, one day, one month)? Even then it might not totally fail, worse still it may become an intermittent, or latent failure.

Avoiding Damage

To provide the best possible protection against static damage two major areas need to be addressed. First, the generation of electrostatic charge should be minimised. Second, special areas should be set up for the handling of static sensitive devices (SSD).

The modern world is filled with plastics of all sorts, all of which lie at the opposite end of the triboelectric series to air and skin; hence any relative movement between common plastics and air or skin will generate a high charge.

This effect is particularly pronounced at low levels of humidity. At typical office temperatures, staff begin to experience slight shocks from metal office furniture, door knobs etc at around 40% relative humidity (RH). Since most humans feel no shock below about 3 kV, it is clear that this implies a high risk of ESD damage to ICs. If RH drops to 15%, charge potentials rise to 15-25 kV, which is painful to humans and lethal to semiconductors.

Humidity may be controlled in several ways, including humidifiers built into air conditioning units, separate humidifiers in ESD control areas, the use of decorative fountains, and the spraying of carpets with water or a humectant that improves the water absorption of the carpet (this does not increase the air humidity, but the effect on charge generation by the carpet is the same). Whatever method is used, a RH level of around 50% is an ideal target; higher levels are better for ESD control but tend to lead to problems such as corrosion and staff discomfort.

A more subtle problem occurs where there is underfloor heating, when the RH of the carpet may be 5 to 10% lower than that of the air above it, leading to unusually high levels of charge.

Floor Surfaces

To avoid static charges building up on people, the ideal working environment includes a rough, unpolished, grounded conductive floor. Considerations of cleanliness tend to militate against rough flooring, leaving floor-

ing materials such as conductive resins, tiling and carpeting as practical alternatives. Ideally, these should be connected to a grounded metal grid system. For any given atmospheric conditions, wool or nylon carpets tend to give lower charge levels than acrylics (polypropylene is the worst of all for charge generation). There is a wide variety of purpose built benching and matting now available for work surfaces, from conductive laminate benchtops to conductive matting, all of which is perfectly serviceable when used correctly.

A special handling area, whether it is a purpose built, air conditioned, humidified, shielded area in a manufacturer's premises or the area created by a field service engineer at a customer's site, is designed to minimise the static charges present so that components or PCBs can be safely handled for say, packing, installation or repair.

The field service engineer can create his own special handling area by use of a conductive or dissipative bench mat, connected to earth via a 1 MOhm resistor. He also needs a wrist-strap, again connected to ground via a 1 MOhm resistor so that any built up charge is gradually bled away. Clothing and overalls should be made of natural fabrics.

Safety

The 1 MOhm resistor serves a dual function. First, it protects devices from too rapid a discharge. For example if you placed a PCB which carried some static charge directly onto an earthed metal bench top, the discharge of the static would be very quick and more damaging than if the resistor had not been there to slow it down. Second, the strap provides personal protection from electric shock should you, for example, come into contact with the mains while wearing a wrist-strap.

There is an enormous range of materials and containers now available for the safe handling, storage and transport of SSD and assemblies. These include metallised "Faraday cage" enclosures, volume-conductive and surface conductive materials and non-conductive antistatic materials.

Note that surface conductive materials such as "pink-poly" work by absorbing a surface film of moisture, which may corrode the item you are trying to protect.

Management Support

There is little chance of effective ESD control without the active support of management. Managers at all levels must be made aware of the true costs of inattention to ESD control, in terms of loss of reputation and high service costs. One of the side benefits of management education in ESD control is the increased awareness of its importance. An ESD aware manager will notice and attempt to correct defects in control procedures that might be missed by hard pressed field service engineers. There is also little point in engineers taking all the precautions necessary when a well meaning user at a customer site comes along and picks up a component or PCB with no regard to proper handling.

ESD is a serious and growing problem for many electronic devices - not just computers. More and more organisations with Quality Systems installed, either ISO9001 approved or not, insist on static protection procedures being followed to ensure that the equipment they are responsible for maintaining has the highest possible reliability.

PCSA

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Re-engineering The Support Team

Setting up a new PC support department? Considering reorganizing your existing one? Leigh Edwards offers some advice, in this concluding half of his article.

Customers want support staff to do four things while solving a problem:

- Take responsibility for the specific problem.
- Get a quick solution.
- Deal with a minimum number of people in reaching a solution.
- To shield the customer from complexity.

Where a problem is likely to take some time to resolve, keeping the user regularly informed of the current status will avoid unnecessary anxiety and enhance the reputation of the group.

Points Of Contact

Establishing a single point of contact, eg, a help desk with one phone number for all support problems, can have benefits for both sides. It simplifies the situation for the user, as they don't have to remember who deals with what type of problem. It also allows support staff to monitor demand and trends more easily.

The disadvantages of providing a help desk service are that the phone has to be constantly manned, tying down one or more individuals. Also, users are less inclined to help themselves and are more likely to call with trivial problems - why should they spend a few minutes reading a manual when there's a trained expert on the end of the phone? (Charging users for support against a departmental budget is one way round this.)

Within a support group, manning the help desk is unlikely to be one of the most sought-after jobs, but it does need to be done well, by people who can represent the group appropri-

ately. Having the best technical person on the help desk is unlikely to be the best use of their time, or do a lot to enhance the reputation of a support group. Unless they're a born diplomat, their frustration and impatience are bound to come across.

Key Systems

For key systems, where users make regular support calls, they often prefer to deal with a specific individual in whom they have confidence. If you are keen to track the use of all support effort, it is important that a mechanism exists to record these demands as well. Dealing with specific individuals can help to foster a more human face to the support group. It can be counter-productive however, if there is a significant turnover of staff for a specific aspect of support. Users can become confused and disillusioned if, every time they call for help, someone new is handling queries for their system. When users are passed from person to person only to be told "I no longer cover that area, you need to speak to ...", this is really bad news for customer relations, whether the customers are internal or external.

Resource Management

As a matter of policy, or maybe due to limited resources, you may decide not to provide detailed "how to" assistance for applications software unless the user's situation is critical. It may be necessary to politely discourage users from calling with minor problems and to consult the manual or use the applications' in-built help.

Getting users to read the documentation first, rather than just picking up the phone, can be difficult at the best

of times. One strategy you might consider is to provide supplementary documentation for your standard workstation applications in the form of an "idiot's guide". That is, a collection of all the common pitfalls and their solutions, clearly laid out and written in plain English. Each workstation should be issued with a numbered copy and users should be encouraged to contribute their tips and (polite) comments. Collect them all in periodically and reissue them, updated with the new hints and tips, giving credit where due. [See PCSA article M0307 for hints on how to write documentation for users - Ed.]

Geography

Geographical location is often an important issue. There may be many occasions when it is necessary for a member of the support team to visit a user's work area to resolve a problem. Appropriate siting of the support team can save a lot of wasted time travelling back and forth. Where there is a large and widely dispersed user community, it may be best to split the team across more than one location. If the majority of the PCs are networked this can be much less of a problem, since many utilities now exist which allow remote operation and investigation of user workstations.

Consider very carefully the implications of providing support if a significant number of your users have company PCs at home or use portable systems. Home based workstations can be very inconvenient and time consuming to support. Support staff may have to travel out to work on them at a time when the user is available to give them access.

Information Centres

Many organisations have arranged their support teams and facilities around the concept of an "Information Centre". Typically this is an office area, where the support staff are located or are close by. They are usually well equipped with software, high end PCs, peripherals, communications facilities, LANs etc. Information Centres provide a useful way of enabling users to evaluate or gain access to more unusual or up to date equipment and software, or receive one-to-one assistance.

Feedback

To keep the support in tune with user requirements, regular feedback is essential and should occur in both directions. Seek honest information, from users and their management, about their perception of service quality and any changes in their needs.

When significant changes occur within business areas, users and management need a clearly defined mechanism for initiating corresponding changes in the support arrangements.

It is important to provide feedback to the users on the level of service actually provided. Hopefully this will reassure them that the support resources are focused on the areas of greatest payback to the business. It may be appropriate to define some criteria to measure performance, such as the number and type of calls received, the average time to resolve a problem and so on. This type of information can be fed back to users and information on specific recurring problems can point out where additional user training is required.

Support teams often produce sophisticated newsletters containing news and performance information but these can be time consuming to produce. In my experience newsletters often go to the bottom of the in-tray and are rarely read. The most effective means of maintaining and enhancing a group's image is through personal contact with staff who present a concerned and helpful approach.

Effects Of Change

Constant change is a necessary fact of life in business today and is particularly so in the IT field. Unfortunately many people do not welcome change. It sometimes appears that advances in hardware, communications and particularly in software are happening every day. With software it seems almost essential to adopt upgrades to continue to receive support from the suppliers.

Minimising the effects of change on users is mainly a matter of careful planning, attention to detail and adequate training. For example, don't jump at all the latest software upgrades, unless you're plagued with major bugs or desperately need the new functionality. It often makes sense to stay one or two minor steps behind. Plan in additional training when important applications are going to change. If money allows, try to buy hardware with some headroom, eg, more RAM and disk space than are currently needed. Avoid stretching old hardware beyond sensible limits, eg, don't put Windows on anything less than a 386. When upgrading a user's established communications facilities, if possible leave the current facilities in place as a backup and only withdraw them when the new ones are proven and stable.

Training

Users must be adequately motivated and equipped to use the technology with which they have been provided. Costs associated with not training can be as much as six times that of providing training (Source: Gartner Group, March 1993). A considerable amount of time can be lost in getting to grips with the new technology. Training maximises the benefits from applications software, by increasing knowledge of the package and, consequently, user productivity. Studies conducted on the use of their applications software by Microsoft led them to define a 95-5 rule of thumb, ie, an average user spends 95% of their time using only 5% of the facilities provided in a package. Adequate training

will also reduce the number of calls on the support team.

Direction

To get more value from training it should be directed at the most appropriate applications areas and be in line with the overall IT strategy. Carefully evaluate current and future training needs. Try to get an accurate evaluation of levels of knowledge among users, support staff etc. After training has been provided get an assessment of its effectiveness and quality. This is useful information for evaluating suppliers and modifying future training plans. [See PCSA articles M0209 and M0123 for information on planning and executing PC training sessions - Ed.]

Training provided for users, support staff and management will have to be tailored appropriately. In general, user training will be in the main business applications. Support staff may also need applications training, usually in more depth, if they are to provide detailed help to users. Specific technical training will almost certainly be needed to allow them to support the IT infrastructure effectively. Individuals, from an entirely technical base, may also benefit from specific business appreciation courses. Business managers, who wish fully to exploit IT, may require some periodic updates on appropriate technological advances and their likely implications and opportunities for the business.

Major software vendors and distributors normally run training courses in their products. These courses are often specifically designed to train support staff, though often the courses are open only to dealers. If this is the case, you may find that the company will agree to part with a set of the course notes to allow you to train your own staff.

Training Options

Options for providing training have never been wider, similarly the range of costs is enormous. External training courses are often excellent but can be very expensive, especially when travel, accommodation and general expenses are included. The

Re-engineering

same supplier may provide their courses on your site and this can reduce the cost considerably.

Before booking an on-site training session, check whether costs are per delegate, or per trainer per day. Find out if there are limits on numbers per course and if the charges include other expenses such as accommodation, transport and equipment hire. Some companies allow staff free time to do self training, but the effectiveness of this approach depends upon the quality of the documentation, tutorials, etc. supplied with the package. Many excellent computer based training packages now exist, many using interactive multimedia. Also, there are video based training packages available for virtually all of the major PC applications. With prices for videos starting at less than \$30, there's no harm in buying in a few copies of all relevant tapes and offering a free loan service for staff in order to help them get a basic overview of packages that are new to them.

Support Administration

According to a report by the Gartner Group published last year, PC administration is often performed in "a fragmented, manual and dispersed manner; often, the burden of administration tasks is borne by the technical support personnel, to the detriment of their primary responsibility of delivering end user support". This statement is borne out by my own experience. Budget forecasting and control, procurement and distribution, recording of expenditure, internal IT charge out systems, maintaining inventories - all of these activities may be important, particularly in larger organisations, but they are all significant consumers of valuable support effort.

The hardware component of an installed IT base is difficult enough to track, but software is even more complex and has inherently higher costs and risks. Managing software distribution, licences and compliance, handling of upgrades and change management have become critical issues for companies who wish to comply with the law.

Other significant activities include:

communications and networking changes and record keeping; setting up maintenance contracts and arranging repairs; managing the capital asset register; tracking orders and deliveries; equipment redeployment and disposal.

All these activities take time and detract from the prime role of actually providing support for users. It's important, therefore, when assigning duties to team members, to ensure that each of these activities is catered for in order to prevent last-minute panics when, for example, an important task needs to be done and there is no-one who is qualified or available to do the work.

Many support groups are the primary contacts with suppliers for the latest technical information and prices. Some groups even act as stockists of commonly used consumable items, cables, connectors, software and interface boards. All of these activities have the potential to dominate, and can grow to severely reduce the resources available to provide quality support and development effort for users. Plan carefully, to avoid such situations.

New Technology

There are many options for utilising new technology to meet the increasing technical demands, whilst minimising costs, and improving customer service. Use of specialist "Help Desk" software, now widely available, is a useful way of managing the support needs of users and many of the associated administrative tasks. Typically, help desk systems allow logging and tracking of user problems, recording of solutions and can assist with managing inventories of hardware and software and even keep staff training records.

Logging details of problems and solutions ensures continuity of approach from staff to any particular problem. Maintaining a "Corporate Memory" helps the replacement staff when changes in the support team have occurred. Statistics gathered can be used to anticipate and avoid the same problems with other users. Help desk systems can be used to fully man-

age the interface between the user base and the various service providers who may be engaged by the company, including the hardware maintainer and LAN support provider.

A help desk operations review can be used to define and refine the long term strategy for delivering support services to PC users. *[We are currently preparing a review of some of the major help desk packages for publication in a future PCSA - Ed.]*

LAN Management

In companies where LANs are widely used, many aspects of administration are becoming easier for support groups. The number of LAN management products is rising every day, and standards such as SNMP are emerging so that LAN admin tools from different vendors can work together under one API. Software tools that enable electronic software distribution, remote auditing and licence management are now widely available. Also there are numerous inventory management products that can automatically keep track of a diverse range hardware, software and system configurations.

Standards

A crucial part of an IT strategy is the definition of key infrastructure elements and standards for hardware, software, networking and systems. Even though some users may view such standards as unnecessary restrictions placed upon their freedom of choice, they are a vital element in controlling support costs and keeping the task within manageable bounds.

The possible options and permutations for choice of hardware platforms, operating systems and applications software are almost endless. Reducing the complexity and variety with which both the users and the support group are faced is essential. A support group should define and document how items of hardware and software are to be installed and configured. The way an operating system, user interface or particular application is installed should not be redefined each time it is done. Vital files such as

CONFIG.SYS, AUTOEXEC.BAT and .INI files, for example, should be the same wherever possible, and variations from the norm should be clearly documented.

If you organise your users' backup routines so that program directories are not included in the daily (or whatever) backups, ensure that you include commands in the AUTOEXEC.BAT file that copy important .INI files to a directory that will be backed up. While re-installing an application from master disks is relatively easy, reconstructing macros, colour settings, modem settings, workgroup definitions etc that have taken years to create is not so straightforward and the user will feel lost without them.

Printing Support

Printers and printing are the greatest cause of calls to a support department. This is particularly so if the printer is connected to a network and used with multiple applications.

Despite the fact that there have been considerable advances in printer technology in recent years, they still tend to be difficult to set up and use. Printer manufacturers have been competing on technical features such as speed, paper options/capacity and font support and have only recently begun to really address ease of use. Sharing expensive, high quality printers on a LAN seems like a sensible and cost effective decision, but it often means that users experience more printer problems. In some cases 50% of the support calls on a network can be related to printing problems.

When planning and staffing a support team, take this situation into account.

Ownership

Decide who should "own" specific printer problems. Users with some basic knowledge and training will avoid tying up support staff with jobs such as adding paper, changing toner and clearing paper jams. It's worth checking out the service arrangements and response times before buying a new printer, especially if it is to be the main or only network printer. Multi-

purpose network printers can reduce initial capital outlay. On the other hand multiple specific printers allow users to choose the most suitable type for a particular job and may keep running costs down. For example, by using a colour device only when appropriate and by reducing the need to change stationery.

Security

Many organisations, and particularly individuals, grossly underestimate the value of data held within systems and their dependence on its continued availability. As a result they are often ill prepared to deal with, or worry about, any significant degree of data loss.

Security is a question of assessing possible risks and balancing those risks against the probable cost to the business. Consider the possibilities of specific disasters such as fire, flood, vandalism, virus damage, hardware failure etc and work out whether the risk is serious enough to warrant doing something about it.

Confidentiality is, of course, vital in some areas but for most commercial organisations integrity and availability of data are the prime considerations. Consider the issues and constraints and any regulatory requirements that may govern your industry. It is advisable to define a company security policy for individuals and support staff.

Data on personal workstations tends to be considered as such, but in reality the data is the property of the company. It is up to the company to make it clear who is responsible for its protection. If the support group does not provide a service covering all data backup, restoration and archiving, they should provide advice and assistance to users with the selection of suitable equipment and design of safe backup regimes. The support group should also check that important data files are indeed being backed up regularly and correctly. The only way to do this is to try restoring the data and check that it is a faithful copy of the original.

Plan carefully the way that users of highly confidential data are going to

be supported. Will the entire support team have supervisor access to the server on which the critical files are held? If the Chairman needs help with Excel to design a spreadsheet for a major takeover battle, who should be sent to do the work? Again, think about this before the situation arises.

Viruses

Viruses are a constant threat to most companies. Loading a virus onto a PC connected to a network can cause a major disaster and has been known to bring companies down. The best policy is one of prevention and user education. It is advisable to declare a policy and define working practices to limit, control or even prohibit the movement of media. The costs of virus investigations and clean-up after infection can be extremely high. As a minimum strategy, arm the support group with industry standard virus checking software. Better still, provide virus scanners to all users who have to handle floppy disks from other users or where disks move between the office and home.

Many specialist training courses and software utilities are now available to help recover data in the event of a disk crash. Some larger organisations make such training and software available to some of their support staff. This may not be appropriate for your company and there are specialist firms who will attempt all manner of data recovery. The costs of such work can be very high, but the value of the lost data may justify it.

PCSA

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Optimising Winword And Excel Installations

Dave Stott shows how to tidy up an installation of Excel or Word for Windows, to reduce disk space and make the programs run more efficiently.

Applications software, particularly Windows-based software, has become very sophisticated and consequently extremely resource hungry. As a result, the amount of hard disk space that certain packages consume can be quite a problem. This article is designed to help you reduce the disk space overhead of the most common Windows applications whilst at the same time enable you to control and manage the various options and features available to your users.

Most software consists of different elements, and you can choose whether to install (or not) each of these. Therefore, you can save considerable amounts of disk space by not installing all the options. However, the standard set-up programs often provided with most packages will not always produce the most optimal configuration. By carefully removing certain files it is possible to fine tune an installation. In this article I'll show how to tune Word for Windows 6.0 and Excel 5.

Word 6 Setup

The Setup program for Word 6 is fairly flexible and it allows you to choose between a Typical, Complete or Custom, and Minimum installation. The Typical Installation option, which will eat around 15 MB of hard disk space, will install the most commonly used Word components, including the spelling and grammar checkers, the thesaurus, and on-line Help. In addition, supplementary Microsoft applications such as Wordart and Graph are installed. During the Typical Setup option you are given the choice of excluding the CLIPART if you wish.

The Complete/Custom Installation requires approximately 24 MB. This option will either install the entire Word package or allow you to cus-

tomise your installation by selecting individual components to include or exclude. During selection, Setup displays the approximate amount of disk space consumed.

Minimum Installation takes approximately 6 MB. It installs the most basic configuration consisting of Word, the spelling checker, and the

Word Readme Help file. The Minimum Installation is particularly useful on laptops or when you have a limited amount of free disk space available.

Once you have installed Word 6 you can get a list of all the files installed by each setup option by looking in the README Help topic.

In addition to the files and subdi-

\WINDOWS					
Filename	Type	Bytes	Filename	Type	Bytes
DOSAPP	INI	43	ALGER	FOT	1,312
MSFNTMAP	INI	2,041	ARLRDBD	FOT	1,335
MSTXTCNV	INI	535	BOOKOSB	FOT	1,332
ODBC	INI	543	BRAGGA	FOT	1,318
ODBCINST	INI	518	BRITANIC	FOT	1,321
ODBCISAM	INI	103	BRUSHSCI	FOT	1,332
TTEMBED	INI	280	COLONNA	FOT	1,316
WINWORD6	INI	994	DESDEMON	FOT	1,314
WORD	GRP	3,067	FTLTLT	FOT	1,332
FSSELPT1	PCL	6,888	GOTHIC	FOT	1,324
\WINDOWS\SYSTEM			IMPACT	FOT	1,308
Filename	Type	Bytes	KINO	FOT	1,310
COMMTB	DLL	40,784	LATINWD	FOT	1,316
COMPOBJ	DLL	101,888	LINEDRAW	FOT	1,318
CTL3DV2	DLL	21,648	MATURASC	FOT	1,346
FINSTALL	DLL	201,008	MTEXTRA	FOT	1,312
HPPCL5E1	DLL	75,468	PLAYBILL	FOT	1,312
HPPCL5E2	DLL	58,672	DRVACCSS	HLP	50,469
HPPCL5E3	DLL	100,001	DRVDBASE	HLP	54,455
HPPCL5E4	DLL	24,576	DRVFOX	HLP	55,004
MSJETDSP	DLL	85,792	DRVPARDX	HLP	54,540
MSTOOLBR	DLL	8,752	FINSTALL	HLP	21,658
ODBC	DLL	49,584	HPPCL5E	HLP	23,119
ODBCINST	DLL	82,704	HPPCL5EO	HLP	17,619
OLE2	DLL	312,320	ODBCINST	HLP	17,412
OLE2CONV	DLL	57,328	OLE2	REG	24,597
OLE2DISP	DLL	90,112	ALGER	TTF	69,496
OLE2NLS	DLL	99,184	ARLRDBD	TTF	39,960
OLE2PROX	DLL	55,808	BOOKOSB	TTF	68,216
PDX110	DLL	189,168	BRAGGA	TTF	33,956
PUBOLE	DLL	78,928	BRITANIC	TTF	35,360
RED110	DLL	238,416	BRUSHSCI	TTF	45,728
SDM	DLL	103,904	COLONNA	TTF	49,288
SHARERES	DLL	37,888	DESDEMON	TTF	54,468
SIMADMIN	DLL	160,080	FTLTLT	TTF	78,096
SIMBA	DLL	469,904	GOTHIC	TTF	61,280
STORAGE	DLL	157,184	IMPACT	TTF	56,936
TTEMBED	DLL	102,912	KINO	TTF	28,872
XBS110	DLL	263,840	LATINWD	TTF	39,188
HPPCL5E	DRV	399,888	LINEDRAW	TTF	80,008
ODBCADM	EXE	6,496	MATURASC	TTF	46,044
			MTEXTRA	TTF	7,656
			PLAYBILL	TTF	40,528

Figure 1 - Files which may be installed in your Windows directories by Word 6 Setup.

rectories which are installed in the main Word directory a number of files will be placed in both your main WINDOWS directory and your WINDOWS\SYSTEM directory. See Figure 1 for details.

Although the Setup program has an option to completely remove Word 6, thereby effectively de-installing the package, it does not actually remove everything which was originally installed. Both the files it places in your main WINDOWS and WINDOWS\SYSTEM directories and any subdirectories that Setup creates are left behind. Therefore if you wish to remove Word 6 completely you will have to perform some manual deleting

\WINDOWS\MSAPPS\EQUATION
\WINDOWS\MSAPPS\GRPHFLT
\WINDOWS\MSAPPS\MSGRAPH
\WINDOWS\MSAPPS\MSINFO
\WINDOWS\MSAPPS\PROOF
\WINDOWS\MSAPPS\TEXTCONV
\WINDOWS\MSAPPS\WORDART
\WORD6\CLIPART
\WORD6\LETTERS
\WORD6\MACROS
\WORD6\SETUP
\WORD6\STARTUP
\WORD6\TEMPLATE
\WORD6\WORDCBT

Figure 2 - Complete Word 6 directories which can be safely deleted if the functions they provide are not required.

File	Effect
\windows\system\ttembed.dll	none
\windows\system\ctl3dv2.dll	none
\windows\system\ole2conv.dll	none
\windows\system\ole2prox.dll	none
\windows\system\commtb.dll	none
\windows\system\mstoolbr.dll	none
\windows\system\ole2.reg	none
\windows\msapps\grphflt\pictimp.flt	none
\windows\msapps\grphflt\ms.pct	none
\windows\msapps\msinfo\msinfo.exe	none
\windows\msapps\proof\mspel2.dll	error messages...
\windows\msapps\proof\mspel2_en.lex	...from spell checker
\windows\msapps\textconv\word2win.cnv	unable to convert
\windows\msapps\textconv\writwin.cnv	unable to convert
\word6\setup\setup.stf	none
\word6\custom.dic	none
\word6\wordhelp.dll	help resources reduced
\word6\normal.dot	automatically recreated
\word6\dialog.fon	none
\word6\wdreadme.hlp	this help unavailable
\word6\winword.opt	automatically recreated
\word6\winword6.reg	none

Figure 3 - Following a Minimum Installation of Word 6 these files may be deleted.

in order to tidy up afterwards.

The Word 6 Setup program uses information in the file SETUP.STF to determine certain installation parameters. This file is compressed on the standard distribution floppy disks so you cannot access it until after you have completed an initial installation. If you are setting up Word 6 for use on a network you can modify the SETUP.STF file to specify which components to install on workstations and in which directory Word 6 should be installed. In addition you can use the /q option when running Setup across a network to perform a "silent" installation with no user interaction. Refer to the Word Help Readme topic for more details on network installation.

Copying Disks

Unlike most other Microsoft applications, you cannot just copy all of the Word 6 distribution disks into a single directory on your hard disk and then run Setup from there. The Setup program needs to access the individual disks, so in order to get round this you need to create a series of sub-directories with the names DISK1, DISK2, DISK3 etc. Then you have to copy each of the distribution disks to their relevant sub-directories. This procedure then allows you to run Setup from the directory DISK1.

Although you can buy Word 6 as a specific product you may also purchase it as part of the Microsoft Office suite. In this case you will also have to install the Microsoft Office Manager. However, you cannot install the Office Manager by itself and you must install Word 6 first.

Saving Disk Space

Depending on the Setup options chosen, several supplementary applications will also be installed along with Word 6 itself. These can be found in the directory WINDOWS\MSAPPS and many of them are common to other Microsoft applications which you may be using such as Excel 5. Using the Custom Setup you can exclude all of these from the installation.

If, after you have installed these applications, you remove them using Setup you will be warned that certain components may be required by other applications. However, if you are only using Word 6 you can safely ignore these warnings and remove the files.

Removing the entire directories associated with these supplementary applications can save a considerable amount of disk space - see Figure 2. However, as a consequence, many of the features and functions provided by Word 6 will no longer be available to the end user.

Deleting Unnecessary Files

Despite the fact that the Minimum Installation option in Setup claims to only install the bare necessities of Word 6 there are in fact a few files

File	Bytes
\windows\mstxtcnv.ini	535
\windows\msfntmap.ini	2,041
\windows\ttembed.ini	280
\windows\winword6.ini	6,888
\windows\system\compobj.dll	101,888
\windows\system\ole2.dll	312,320
\windows\system\ole2disp.dll	90,112
\windows\system\ole2nls.dll	99,184
\windows\system\sdm.dll	103,904
\windows\system\storage.dll	157,184
\word6\winword.exe	3,483,136
\word6\wwintl.dll	759,296
Total bytes:	5,116,768

Figure 4 - These are the absolute minimum files required to run Word 6.

Winword & Excel

\WINDOWS			Filename	Type	Bytes
CCARD100	EXE	134,544	MSTOOLBR	DLL	9,200
EXCEL5	INI	1,385	ODBC	DLL	49,584
MSQUERY	INI	120	ODBCADM	EXE	6,496
ODBC	INI	705	ODBCINST	DLL	82,704
ODBCINST	INI	655	ODBCINST	HLP	17,412
ODBCISAM	INI	103	OLE2	DLL	313,344
\WINDOWS\SYSTEM			OLE2	REG	24,598
CCAPI100	DLL	63,328	OLE2CONV	DLL	57,328
COMMTB	DLL	40,784	OLE2DISP	DLL	90,144
COMPOBJ	DLL	102,400	OLE2NLS	DLL	99,200
CTL3D	DLL	20,272	OLE2PROX	DLL	55,808
CTL3DV2	DLL	21,648	PDX110	DLL	189,168
DBNMP3	DLL	10,704	RED110	DLL	238,416
DDEML	DLL	39,424	SCP	DLL	9,904
DRVACSS	HLP	50,469	SDM	DLL	102,032
DRVDBASE	HLP	54,455	SHARERES	DLL	37,888
DRVFOX	HLP	55,004	SIMADMIN	DLL	160,080
DRVPARDX	HLP	54,540	SIMBA	DLL	46,9904
DRVSSVR	HLP	87,839	SQLSRVR	DLL	155,776
MAPIVIM	DLL	49,856	STDOLE	TLB	4,322
MSFFILE	DLL	177,840	STORAGE	DLL	157,184
MSJETDSP	DLL	85,792	TYPELIB	DLL	142,592
			VBA	DLL	820,064
			VBAEN	DLL	9,360
			VBAEN	OLB	31,060
			XBS110	DLL	263,840
			XLCALL	DLL	1,600

Figure 5 - Files which may be installed in your Windows directories by Excel 5 Setup.

which may not be absolutely essential. See Figure 3 for details.

Many of the .DLL files can be deleted, but the bulk of unnecessary files are the extra TrueType fonts which Word 6 installs. These fonts are installed mainly for the benefit of the Tutorial and Example files. Therefore, if you don't need the fonts for anything else you might as well get rid of them to save space. Rather than simply deleting the font files it is best to remove them using the Windows Control Panel as this will also remove any references in your SYSTEM.INI files as well.

\WINDOWS\MSAPPS\GRPHFLT
\WINDOWS\MSAPPS\MSINFO
\WINDOWS\MSAPPS\MSQUERY
\WINDOWS\MSAPPS\PROOF
\EXCEL5\EXAMPLES
\EXCEL5\EXAMPLES\SOLVER
\EXCEL5\EXCELCBT
\EXCEL5\LIBRARY
\EXCEL5\LIBRARY\ANALYSIS
\EXCEL5\LIBRARY\CROSTAB
\EXCEL5\LIBRARY\MSQUERY
\EXCEL5\LIBRARY\SLIDES
\EXCEL5\LIBRARY\SOLVER
\EXCEL5\SETUP
\EXCEL5\XLSTART

Figure 6 - Entire Excel 5 directories which can be safely deleted.

Deleting most of these .DLL files will have no noticeable effect on Word 6. However, deleting some files will cause Word 6 to generate error messages when the user attempts to access

File	Effect
\windows\system\commtb.dll	none
\windows\system\ctl3dv2.dll	none
\windows\system\msffile.dll	none
\windows\system\mstoolbr.dll	none
\windows\system\ole2conv.dll	none
\windows\system\ole2prox.dll	none
\windows\system\ole2.reg	none
\windows\system\scp.dll	none
\windows\system\shareres.dll	none
\windows\system\stdole.tlb	none
\windows\system\vbaen.olb	none
\windows\system\xcall.dll	none
\windows\msapps\msinfo\msinfo.exe	none
\windows\msapps\proof\custom.dic	none
\excel5\setup\setup.stf	none
\excel5\filelist.txt	none
\excel5\network.txt	none
\excel5\xlen50.olb	none
\excel5\xlhelp.dll	disables help
\excel5\xlintl.dll	none
\excel5\xlps.hlp	this help unavailable
\excel5\xlreadme.hlp	this help unavailable
\excel5\examples\bookst.xls	required by tutorial
\excel5\examples\samples.xls	required by tutorial
\excel5\library\updtlinl.xla	none
\excel5\library\crosstab\crossfnc.xla	none
\excel5\xlstart\xl5galry.xls	none

Figure 7 - Following a Minimum Installation of Excel 5 these files may be deleted.

certain functions. Whilst such messages may be rather annoying they will not prevent the user from using the remaining functions successfully.

The Minimum Installation Setup option is quite efficient and even after carefully deleting any unnecessary files you will only gain around 1 MB of extra disk space, as shown in Figure 4.

Excel 5 Setup

The Excel 5 Setup program is almost identical to the Microsoft Word 6 Setup program. It also gives you the option to perform a Typical, Complete or Custom, and a Minimum installation.

Typical Installation takes approximately 17 MB. This option will install the most commonly used Excel 5 components, including the Solver, the Tutorial and on-line Help. In addition supplementary Microsoft applications such as the Spelling Checker and Graph are installed.

A Complete/Custom Installation requires approximately 23 MB. This option will either install the entire Excel 5 package, including any of the optional Excel Add Ins, or allow you to customise your installation by selecting individual components to

include or exclude. During selection, Setup displays the approximate amount of disk space which will be consumed.

File	Bytes
\windows\excel5.ini	655
\windows\system\compobj.dll	102,400
\windows\system\ole2.dll	313,344
\windows\system\ole2disp.dll	90,144
\windows\system\ole2nls.dll	99,200
\windows\system\sdm.dll	102,032
\windows\system\storage.dll	157,184
\windows\system\typelib.dll	142,592
\windows\system\vba.dll	820,064
\windows\system\vbaen.dll	9,360
\excel5\excel.exe	4,185,600
\excel5\excel5.reg	9,903
Total bytes: 6,033,133	

Figure 8 - These are the absolute minimum files required to run Excel 5.

\WINDOWS\MSAPPS\GRPHFLT	
cgmimp.flr	44,912
epsimp.flr	71,984
iffpcx.dll	10,160
ifftifs.dll	32,624
pcximp.flr	11,728
tiffimp.flr	11,728
\WINDOWS\MSAPPS\MSINFO	
msinfo.exe	40,960
\WINDOWS\SYSTEM	
commfb.dll	40,784
compobj.dll	102,400
ctl3dv2.dll	21,648
drvaccs.hlp	50,469
drvdbase.hlp	54,455
drvfox.hlp	55,004
drvpardx.hlp	54,540
mapivim.dll	49,856
msjetdsp.dll	85,792
mstoolbr.dll	9,200
odbc.dll	49,584
odbcadm.exe	6,496
odbcinst.dll	82,704
odbcinst.hlp	17,412
ole2.dll	313,344
ole2.reg	24,598
ole2conv.dll	57,328
ole2disp.dll	90,144
ole2nls.dll	99,200
ole2prox.dll	55,808
pdx110.dll	189,168
red110.dll	238,416
sdm.dll	102,032
sharerres.dll	37,888
simadmin.dll	160,080
simba.dll	469,904
storage.dll	157,184
xbs110.dll	263,840
Total size of common files: 3,163,374	

Figure 9 - Files which are common to both Word 6 and Excel 5.

The Minimum Installation needs approximately 8 MB. This option will install the most basic configuration consisting of Excel 5 itself and the basic Excel Help file. A file called FILELIST.TXT on Disk 1 of the Setup distribution disk contains a full list of the Excel 5 files and details about where these files are installed.

As with Microsoft Word 6 described above, a number of Excel 5 files will be placed in both your main WINDOWS directory and your WINDOWS\SYSTEM directory (see Figure 5). And like Word 6, Excel's de-install option doesn't remove every file. Again, some manual deleting will be required. The note about making separate directories for each floppy disk also applies.

Saving Disk Space

Excel 5 is supplied with several supplementary applications which are installed in a directory called MSAPPS beneath your main WINDOWS directory. Some of these applications may be common to other Microsoft packages and you should check carefully in case they are needed by something else before removing them.

You can remove these supplementary applications using the Setup program but if you do this then although the relevant files will be deleted the associated directories will be left behind. As an alternative you can use the File Manager to delete the entire directory for each particular application (see Figure 6). However, after you have done this you may find that there are still references to non-existent directories in the EXCEL5.INI file which will require amendment.

Deleting Unnecessary Files

Even after using the Minimum Installation option with Setup there are still a few files which are not entirely essential in order to run Excel 5. These are shown in Figure 7.

Most of these extra files can be deleted without affecting the general running of Excel 5. However, certain files will be required for some of the higher level functions such as OLE and spreadsheet conversion. As a result the user may experience sporadic

error messages - these are harmless.

Although the Minimum Installation provides quite a compact configuration, you can save nearly 2 MB of disk space by careful pruning, thus bringing the total disk capacity required to just over 6 MB. For details, see Figure 8.

Common Files

Many of the files which are installed by Word 6 and Excel 5 are in fact common to both applications. In particular the support files for OLE and the various database functions are common. Therefore, if you are using both packages on the same system, the total disk space used will be less than the minimum space required for each individual application.

This means that, in theory, Word 6 and Excel 5 can be squeezed into just 9.8 MB. In practice, however, it is unlikely that your users will be completely satisfied with such a minimal installation and it is best allow some room for expansion and the subsequent installation of optional elements. Installing both applications on the same systems can result in a saving of over 3 MB (see Figure 9).

You may notice that some of the common files have different file sizes, which means that the versions will be slightly different. Check the date stamps on the files to make sure that you are using the latest versions. In general it is fairly safe to assume that the file with the later date stamp is the newer version.

PCSA

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Understanding CPU and RAM Upgrades

There is no shortage of upgrade processors that claim to speed up your PCs. Chris Long outlines the options available and offers advice about installing CPU and RAM upgrades.

Buying PCs is a bit like playing a one armed bandit. You are always faced with the big question: do you continue to spend money and go for the jackpot or do you quit while you are ahead?

If it's the latter, it's best to quickly scurry away so you don't hear the depressing Kajunk-kajunk-kajunk that means someone else has just won the jackpot - and all your money - on your machine.

These days, processor upgrades are very easy and there are solutions to more or less every underpowered PC problem. Only in very extreme cases will you need to replace an entire PC. All you need is a bit of patience and a steady hand, and to invest some time in preparation.

Processor Types

There are a lot of processors around. Among the Intel offerings are the 386SX, 486SX, 486SLC, 486DX2 and 486DX4, plus more from newcomers like Cyrix and AMD and old hands like IBM.

Today the entry level desktop machines rely on a 486, with the 25 MHz 486SX the most popular choice. Intel's 486SX and DX are both full 32-bit chips, though the former lacks the DX's built-in maths co-processor. Both feature an optimized instruction set and an 8 KB internal cache that makes them work faster than the 386. Probably the most simple upgrade path for a 486 that's showing its age is via Intel's line of OverDrive processors. With OverDrive, you simply remove the 486SX or DX and plug a faster chip into its place.

There are two flavours of OverDrive chips, the DX2 and DX4. The upgrade version is the 486DX2, a DX that uses clock doubling technology so the chip can process data at, for example, 50 MHz internally while communicating with the rest of the system at 25 MHz.

Intel recently released a new speeded-up chip for PC manufacturers, called the DX4 (which is a bit surprising given that it is, in fact, clock tripled). This means the processor can churn at 75 MHz while its I/O is still clocked at 25 MHz.

In line with today's energy conscious technology the DX4 also runs at 3.3 V, making it cooler than its predecessors. It has 1.6 million transistors and is the first Intel processor using 0.6 micron technology. Currently it is available at 75 MHz and 100 MHz clock speeds and an 83 MHz version will be available later this year. Running at 3.3 volts will also give DX4 processors an edge with notebook manufacturers and it is compatible with the various power management systems available.

Despite coming in 168-pin 486DX

compatible packaging, as well as in the 208 pin SQFP packaging, the DX4 isn't an upgrade chip, so we will see it appearing in PCs but not as an upgrade option.

Preparation

Before you install an OverDrive, check with Intel or your PC manufacturer that the chip you intend to install is compatible with the particular model of PC. The problems lie in potential BIOS incompatibilities with the new chip and the old system board, plus possible over-heating with the new hotter-running chip.

SX Upgrades

Although it was released after the 486DX, the 486SX is the bottom rung on the 486 CPU power ladder. A lot of industry watchers suggest that the 486SX was launched solely to counter the introduction of AMD's 40 MHz AM386DX processor. Whatever its effect on AMD, the launch of the 486SX certainly confused consumers.

For one thing, it changed the meaning of the suffix SX. While Intel's

"As a rule, you should match the speed of the memory you've already got. You can usually determine the SIMM speed by looking at the part number on the chip. A suffix of "80", for example, denotes 80 ns."

386SX paired the original 386's 32-bit architecture with the more economical 16-bit data bus, the 486SX shares the 486DX's full 32-bit design (inside and outside), as well as its optimized instruction set and internal cache. The only thing it lacks is the matched 487 math co-processor. (And for what it's worth, the 487 is actually present on the 486SX chip; it's just disabled.)

The first 486SX chips were less of a blow to AMD's 386/40 than Intel had hoped, mainly because they ran at a relatively slow 16 MHz and, despite Intel's claims, very few people believed that a 16 MHz chip could be 20% faster than a 40 MHz chip, optimized or not. Later the 20 MHz and 25 MHz versions redeemed the 486SX's name in the performance stakes.

Adding The 487

You can add a 487 to a 486SX if you need to. If you do, you get slightly more of a boost than it would at first seem. The 487 is called the SX OverDrive (as opposed to the SX2) but is basically a fully functioning DX chip that has 169 pins instead of the 168 of the original SX. When the system

Expanding A PC's Memory

If you're upgrading a machine's CPU you'll often find you need to install more memory at the same time in order to run the bigger programs that the new CPU can now handle.

If you're fairly confident, then it makes sense to do the CPU and the RAM upgrade at the same time, to save dismantling the PC twice.

Memory chips are very delicate, so you need to take the proper precautions when you handle them. Always carry them in their anti-static carrying holders and earth yourself before you handle them by touching something grounded, such as a heating radiator or an earthed electrical appliance.

Be careful to buy the right SIMM chips to work with your system too. Their physical characteristics should be easy enough to distinguish. Check the other SIMMs or the sockets.

Standard SIMMs come in a variety of forms, capacities, speeds, and operational parameters, and a correct match of SIMM and system is vital. There are several types of SIMM: 8-bit (Macintosh), 9-bit, and 36-bit. These in turn come in a variety of different capacities.

The most significant difference between SIMMs is in their pinout. Some have 30 pins, others have 72 pins. The 30 pin SIMM is older and more common, but the 72 pin SIMM is starting to appear more widely, especially in high end systems. Check your system's documentation or the manufacturer to get your memory's complete specifications before purchasing any additional RAM.

The 30 pin SIMMs are 9-bit devices since PC memory typically has a parity bit for each data byte. You'll see 30 pin SIMMs advertised as x9s (pronounced "by-nines"). The new 72 pin SIMMs are 32-bit devices (36 bits with parity) and are advertised as x36s.

As a rule, 32-bit memory chips must all be of the same type, although you can mix and match some of the 9-bit SIMMs, but if you don't want any headaches later mixing 9-bit chips is not recommended.

Virtually all 386DX and 486 systems support 32-bit memory addressing, which means that with 30 pin SIMMs you'll need a matching set of four to create a bank of 32-bit memory. Systems typically have two or four banks, each of which must either contain four matching SIMMs or remain empty. In 286 and 386SX systems with 16-bit memory addressing, each populated bank is made up of two matching SIMMs.

The surest way of getting the chips you need is to buy them from the manufacturer of your system. Alas their prices are generally going to be a lot higher than those you'll find from third party memory sellers. So it is imperative that you know exactly what type of chip you need.

Speed is the next consideration. The chips used in SIMMs are available in a number of speed ratings, given in nanoseconds. Current mass production SIMMs are typically rated at 70 ns or 80 ns, although memory as slow as 120 ns or as fast as 53 ns is sometimes used.

As a rule, you should match the speed of the memory you've already got. You can usually determine the SIMM speed by looking at the part number on the chip. A suffix of "80", or "-8" for example, denotes 80 ns.

If you can't get the 80 ns SIMMs you need, you can often use faster (70 ns) parts instead. But this is not always the case - check with the manufacturer of the PC in question.

Some systems let you mix memory of different speeds, though you shouldn't expect better memory performance from faster SIMMs unless your system manual states this to be the case. Watch out for paying for a speed rating you don't need.

After the upgrade, you may need to tell the PC that it now has more memory than it had before. The PC may automatically adjust, or it may notice that the amount of memory has changed and automatically take you into the CMOS settings so you can enter the new total.

With some BIOSes, you need to press Ctrl-Alt-S to enter the setup screen, while others require you to turn on the PC with the INS key or a function key held down.

Upgrades

senses the extra pin it switches off the original processor and allows the 487 to run the system as a 486DX2 PC. This negates the speed hit of shunting data between two separate processors. Thus, the DX OverDrive chip for the 486SX is in fact a 486DX2 OverDrive processor (clocked at different speeds). So an OverDrive upgrade turns a 486SX/25 computer into (more or less) a 486DX2/50.

In this case the new chip goes into the empty 487 socket, but there are sometimes special sockets set aside that are specifically for system upgrading. Of course, if you don't have a spare socket you have to plug the new chip in to the main processor socket after carefully levering out the old one.

Enter The SX2

Just to confuse things even more, Intel launched the 486SX2 OverDrive processor. It is, amazingly, a clock doubled SX processor for SX users who like not having an integrated maths co-processor. It uses the same speed doubling technology found in the DX range and comes in both 20 MHz (40 MHz internally) and 25 MHz (50 MHz internally) versions. The chances are that this is really a product to grab a price point and give Intel another go at warding off the hordes of other microprocessor manufacturers.

BIOS Considerations

Because the OverDrive chip runs faster than the standard chip some BIOS systems get confused when they get information back quicker than expected. Clock-dependent timing loops and firmware routines can be overwhelmed by the doubled internal speed of the CPU. Intel and several BIOS manufacturers have worked to correct the situation, and in most cases where an incompatibility exists, a BIOS upgrade should be available.

Therefore it is imperative to check with Intel to see if there are any procedures you need to go through before you upgrade. For example, Dell will sell you the latest BIOS chips for your PC which will support newer equipment.

"When you take apart the PC, there's a good chance that the CMOS chip will lose power and so the machine will forget the details of the hard disk type. So before you start, make a note of the CMOS settings."

Don't Throw Away That 286

Most people agree that attempting to upgrade a 286-based PC is really not worth the trouble or money. But it isn't the end of its life - the machine can be put to good use until it gives up the ghost.

It can be used as a word processor. There is almost certainly someone who hasn't dumped their typewriter and needs to learn how a PC works. A 286 system will work fine for this. Make sure you use a good DOS-based word processor like WordPerfect 5.1 for DOS.

Alternatively, keep the 286 box as part of a backup system. It may not be ideal, but at least it will allow someone to get some work done.

If there's a member of staff who needs or wants a PC to use at home, to work on documents, old 286s are often ideal. For simply tidying up the draft text of a report, there's no need for anything more powerful.

And if you're thinking of running a bulletin board for customers or staff, where most of the PC's time will be spent talking to a modem, a 286 box is fine.

You can use an AT as a network print server. A very few new network printers let you connect right into the network cabling, but most need to plug into a PC to be able to talk to the network. A low-powered system works just fine for this purpose.

You might try setting it up as a voice-mail system. A number of reasonably priced add in boards deliver voice-mail capability for far less than dedicated systems. Just make sure you equip your AT with a 300 MB or larger hard disk - more upgrading but it could well be worth it.

There are more "philanthropic" approaches to using old computers. Obviously it will be good publicity and be a very efficient solution to the problem. Schools and other institutions will be more than happy to take old hardware and (subject to licence conditions) software off your hands.

Finally, give or sell the old machines to staff.

One last point: Before you finally dispose of an old PC, check that any old backup diskettes produced by its drives can be read in the machines which remain. A PC with a drive whose head is slightly out of alignment will often lead to problems. It's not uncommon for a company to find that important disks from the archives cannot be read by any of its modern PCs.

The faster OverDrive chips have heatsinks on them, meaning you'll have to check for clearance above the processor slot (and perhaps take a hacksaw to the offending disk drive bay metalwork, though this may do nasty things to your warranty agreements).

If you have any doubts about the viability of a PC's cooling system there are a couple of things you can do to make it bit more efficient. If there are any blanking panels missing from the back of the system unit, replace them.

Without these panels the internal air pressure is severely reduced which, in turn, reduces the amount of air that the fan can shift over the hot processor. Similarly the fan itself should be clear of dust and anything blocking its vents. Make sure that the system unit itself has a space around it so that it can get a good supply of cool air.

The P24T

Intel doesn't stop with the 486 OverDrive chip. The next generation

OverDrive processor is still waiting in the wings. Currently known as the P24T or Pentium OverDrive it is the next step for 486 users. It will have the 64-bit Pentium processor core, but a 32-bit external data path and among the other features Intel is touting are a 16 KB on-chip cache and a redesigned floating point unit.

As far as the system board is concerned, the P24T still looks like an ultrafast 32-bit processor. It will be plugged in to a special socket on the 486 motherboard that manufacturers are building in to their PCs now.

Due to a "misunderstanding" between Intel and the rest of the world, there are unfortunately some P24T sockets in some PCs that seem not to be entirely compatible with the P24T chips that Intel will be making. Alas, Intel say, it's not an electrical or system problem, but a temperature problem. Because the Pentium runs very hot (well, compared to the rest of its family) some of the 486 systems that have a Pentium OverDrive socket don't have sufficient air conditioning to keep everything running cool (hence the need to make sure that your computer's cooling system is running at maximum efficiency).

This confusion has led Intel to release two types of chip, a 238 pin processor (the original specification) and a 237 pin chip with a fan built into the top of it. Currently there is no word if these two processors will be interchangeable, thus the jury is out as to whether all PCs with a P24T socket will be able to run a Pentium OverDrive processor.

Other Sources

Other manufacturers offer interesting, powerful, and less expensive alternatives to Intel CPUs. Cyrix's Cx486SLC and IBM's 486SLC are hybrid chips, with 32-bit internal and 16-bit external data paths (like the Intel 386SX) but with on-board chip caches and 486 instruction set compatibility. The Cyrix SLC is mostly designed for notebooks, but a 25/50 MHz clock-doubled version of IBM's chip called the 486SLC2 has been seen sneaking into the desktop market.

Cyrix isn't ignoring the desktop

Hints For Replacing A CPU Chip

Whether it is an Intel or Cyrix chip, replacing a processor is a reasonably simple job. It does, though, take time, because you'll almost certainly have to remove the motherboard from the case and put it on a flat surface to work on. (It goes without saying that a full backup, if not two, is a good idea.)

Also make sure that you lever out the chip with the tool supplied and be careful not to get the lever caught between the chip socket and the motherboard - this will be disastrous (don't laugh - it's been done).

When you take apart the PC, there's a good chance that the CMOS chip will lose power and so the machine will forget the details of the hard disk type. So before you start, make a note of the CMOS settings for the hard disk(s), including the type number, and the number of heads, cylinders and so on.

As you dissect the PC, make a note of each step you take. Make the notes on paper, or into a portable dictating machine. Give enough information to allow you to re-trace your steps when you put the machine back together again.

When you are handling the processor try to make sure that you are grounded.

If you are really lucky (and working on a 486) you might come across a zero insertion force or ZIF socket. There are two types: a lever system or a screw system. Both allow you to remove or insert a processor without applying any pressure. The screw system is 17 pins wide and has a screw in the top part of the chip socket. You undo the screw, replace the chip and tighten up the screw.

The lever system is even simpler. Pull the little lever up and the chip pops out, you replace the chip and push the little lever down. That's all there is to it.

For standard socketed chips, it's more difficult, of course. Most upgrade packages include a tool for removing the old chip, though specialist suppliers can often help if you don't have quite the right piece.

When replacing the chip match up pin 1 with socket 1. Some Intel chips have the corner cut off, while others have a mark on the corner of the chip that is the pin 1 corner. The Cyrix processor has a little gold square on its top that tells you its correct orientation.

Upgrades

"Upgrading could well be cost inefficient. Once you have a faster processor will your disk drive slow you up? Will you need more memory to run the new software the faster processor tempts you to install? Will you need a new graphics card and monitor?"

market either. Its Cx486DLC is a full 32-bit rival to Intel's 486DX. It has a smaller cache and uses an external math co-processor, but it does offer a 40 MHz clock speed against Intel's 33 MHz. In the very first 486s there is only one processor socket - the socket that the processor comes in - which means hiking out the old chip first.

Upgrading A 386

Having covered some of the options for upgrading a 486-based PC, let's move down to the 386. There are two approaches to upgrading this system, namely swapping out the chip or replacing the motherboard. We'll start with chip upgrades.

Any 386 or higher chip can run the latest 32-bit software, although the cheapest (and least powerful) of them, the 386SX, funnels its 32-bit internal data path through a 16-bit bus, slowing down its overall performance. The 386DX, by contrast, is a true 32-bit chip and along with AMD's Am386DX, (which runs at 40 MHz against 33 MHz for the Intel 386), are the last survivors in the dwindling desktop 386 market.

The very basic difference between the 386 and the 486 is six processor instructions, although the real explanation goes deeper than that. Compared to the 386, the 486 (at least in the DX version) has an optimized instruction set that lets it execute commands, especially 32-bit commands, faster. Its memory interface benefits from the built in cache controller and

8 KB of on-chip instruction cache as well as a built in math co-processor.

What confuses the issue is that 386 users also have processor caches and math co-processors, albeit as external devices. This leads to the question: does bundling all this inside the chip make a real difference, and is it really worth the upgrade? Unfortunately the answer, at least for the early 486s, was "nearly".

The 486's internal cache uses a design scheme called "four way set association" that supports a data transfer burst mode. In burst mode, four 32-bit words can be transferred in only five clock cycles (two for the first, and one for each of the remaining transfers). In contrast, a best case design for a 386 system would take eight clock cycles because each non-burst transfer requires two cycles. But in the rush to reach the market as quickly as

possible, the first clutch of 486 PCs didn't support this cache burst mode.

The problem was resolved during the first few months of 1990. But even with a major improvement in cache and memory architecture for the 386 as in the few systems that use Intel's fairly complex and costly 82395 cache controller, the 486 family remains faster and the best bet for the future.

The 486's floating point unit (FPU) has taken time to win acceptance, too. When the 386 was king the idea of using a math co-processor was limited to high end CAD and similar applications (such as spreadsheets using cosines, although not spreadsheets that balanced budgets). Since math co-processors were esoteric options, most programs were written to do without them.

As the 486 has become more popular, things have changed. Many mid-level business applications, and even some games, now use the FPU to enhance their performance. Of course, you can get the same functionality by adding a 387 co-processor to any 386, but you don't get the same performance. This is because every time a processor exits its comfortable internal environment and deals with the outside world, things slow down. So while the 386 and 387 pass data back and forth, your applications wait.

Moving the FPU into the 486 abolished these I/O delays. Data only needs to move between two internal registers, communicating as quickly as the processing time of the chip. Naturally, not every PC user needs a

"Although it was released after the 486DX, the 486SX is the bottom rung on the 486 CPU power ladder. A lot of industry watchers suggest that the 486SX was invented solely to counter the introduction of AMD's 40 MHz AM386DX processor."

math co-processor, and the 386 is not yet dead in the marketplace, but even with a cache and a co-processor, it'll always be slower than the 486. Therefore, any decision to upgrade has to take this into account.

Copyright

In the old days a 486 was a 486 and everybody knew that it was made by Intel. Now all that has changed. Intel discovered that it couldn't keep copyright on its 80x86 series and the floodgates opened.

We now have several different 486s that aren't real (as in Intel 486) 486s, but are more powerful than the 386s they aim to replace. The Cyrix Cx486DRx2 is one of these. It looks like a 386 to the rest of the motherboard, but acts like a 486 the instant you get inside it. It also uses clock doubling to achieve its throughput.

One place where it does score highly is in its math circuits. The DRx2 range has a multiplier built in which takes integer calculation into the hardware. Cyrix claims that where an Intel chip (386 or 486) will take 18-20 instructions to process an integer calculation the DRx2 will do it in two or three. And given that integer calculation figures greatly in graphics work, the Cyrix chips look very well placed to help any Windows users interested in an upgrade.

All the same caveats about BIOS compatibility apply. Also both the Cx486DRx2 20/40 (for the 20 MHz 386) and 25/50 (for the 25 MHz 386)

come with heat sinks making both airflow and available height above the processor an issue too.

The only real difference between installing the Cyrix processor and an Intel processor is that the Cyrix needs a small software program run at boot time to switch on some of its registers. Otherwise all the information for the Intel upgrade applies to it.

Older Machines

Although it's possible to improve the performance of an 8088/8086 or a 286-based machine by swapping chips and/or motherboards, it's really not worth it nowadays. There are plenty of ways to use an old machine, and some of these are discussed in the box on page H0620.3.

You can, if you really want to, get accelerator cards for 8088/8086 and 286 machines. These cards contain a new processor and the whole thing

goes into a spare slot on the motherboard. You then lever out the old CPU and plug a small daughter board into the socket. The old processor usually plugs into the board to give boot up compatibility to the BIOS.

Upgrading an old machine like this is expensive and takes time, and the machine that you end up with still isn't exactly fast. Don't do it unless you really have to.

The problem for a lot of 286 owners is some of the 286 chips were soldered on to the motherboard. This effectively makes them impossible to upgrade, unless you desolder the chip and solder a socket in its place. Doing this without specialist machinery, though, is not considered good practice. A better way to speed up a 286-based machine is to replace the entire motherboard.

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"You can, if you really want to, get accelerator cards for 8088/8086 and 286 machines. These cards contain a new processor and the whole thing goes into a spare slot on the motherboard. You then lever out the old CPU and plug a small daughter board into the socket."

PCSA

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